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ON THE NORTHWARD DRIFT OF THE AFRO-ARABIAN AND INDIAN PLATES

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Abstract: Classical reconstructions of Wegener's Palaeozoic or Precambrian Pangaea, have shown a wide "Tethyan Gape" (proto-Tethys ocean) separating Laurasia in the north from Gondwanaland in the south during the early Palaeozoic. More recently detailed geological fieldwork in southern and central Asia has led to a variety of different configurations of continental plates in Palaeozoic reconstructions but most of these retain a fairly wide separation between the two major continents. The Afro-Arabian and Indian plates have been inferred as gradually approaching the Eurasian continent during the Mesozoic and reaching it somewhat later. This paper presents evidence to suggest that these plates were never far from the Eurasian continent and that a "Tethyan gape" did not exist in the Palaeozoic. Moreover, it lends weight to the theory of an expanding earth.

INTRODUCTION

Classical reconstructions of Pangaea, exemplified by Dietz & Holden (1970) and then addressed by palaeontologists (Cowie 1971, Bulman 1971), suggested a Tethyan Ocean, a few thousand kilometres wide between Laurasia and Gondwanaland in the Palaeozoic. Early workers considered that the Afro-Arabian and Indian plates closed this ocean by northward drift that began in the Permian and ended in the Cretaceous. More recent work suggests that these events occurred later in the Mesozoic. An elongate WNW to ESE subduction zone along the southern edge of Laurasia has been assumed during these events and all the oceanic crust of the Tethyan ocean is assumed to have disappeared down this zone.

Finally the Afro-Arabian and Indian plates are believed to have collided with Laurasia and ophiolites are believed to mark the collision boundary at the surface although the plates underthrust beneath Laurasia in the Tertiary, uplifting central Asia to its present height.

INDIAN-EURASIAN PLATE BOUNDARY

The presence of the *Glossopteris* flora and sections and other fossils typical of Gondwanaland during the Late Carboniferous and Permian in a 50 km belt from Longda, Selong, Qubu to Quzong north of the main Himalaya (Hsu 1976) indicate that the Himalaya was then in the interior of Gondwanaland.

The supposed Indian-Eurasian plate boundary has been located along the upper Indus and Tsang-Pu River Valleys by recognition of a line of ophiolites (Yin & Guo 1976, Hsu 1976). It has been suggested (Bulman 1971, Takin 1972) that the Zagros Thrust north of the Persian Gulf was an extension of the same collision zone and marked the old Tethys Ocean but Stocklin (1974) has suggested that it is a comparatively young tectonic feature and the collision zone in that area was well to the north. Much has been written on the tectonics of southern Asia and it is not the intention to establish any new palaeogeography in this paper. Rather it is intended to add weight to Stocklin's (1974) arguments and to suggest that the wide Tethyan Ocean did not exist in the Early Palaeozoic and probably never existed at all.

FAUNAL AND LITHOLOGICAL COMPARISON ACROSS THE BOUNDARY

Cambrian Faunas of Iran (Fig. 2)

Much has now been written about the Cambrian faunas of Iran (King 1937, Kushan 1973, Fortey & Rushton 1976) and in the region of the Zagros Thrust line some Middle and Late Cambrian trilobite genera (e.g. *Iranoleesia* and *Chelid-*

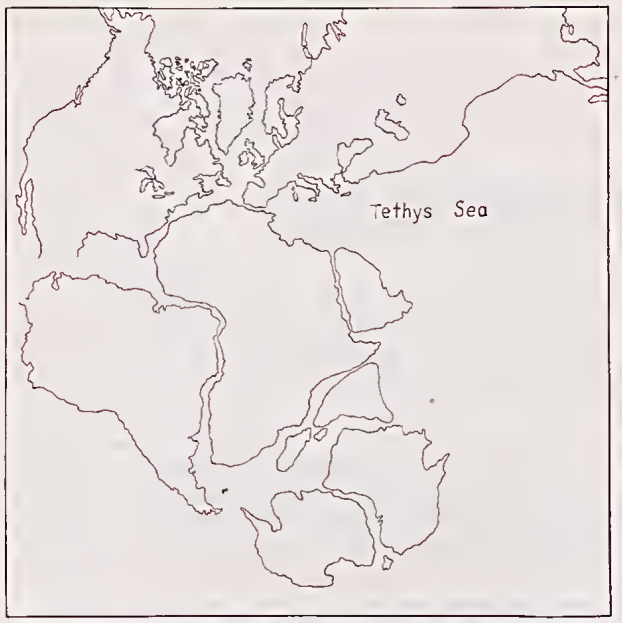

FIG. 1—Reconstruction of Laurasia and Gondwanaland during the Early Cambrian (After Cowie 1971, fig. 4)

onocephalus) occur on both sides of the thrust line and nowhere else in the world. Most of the Cambrian trilobites of Iran both north and south of the thrust line are also to be found in China. If the Zagros thrust line was a collision boundary and represents a wide Palaeozoic ocean (Takin 1972, Bulman 1971) then the distribution of these faunas would be anomalous. The suggestions of Stocklin (1974) that the Zagros Thrust Line was not a collision boundary representing a wide Palaeozoic ocean, accord far more with the palaeontological evidence.

Cambrian Shelf Sequences and Faunas of the Northern Indian Peninsula and China (Fig. 3)

The Cambrian sequences in the Salt Range, Pakistan and in Yunnan, Southwest China correspond closely lithologically and contain the same sequence of fossils. Table 1 gives the correlated stratigraphic sequences for the two areas.

The Salt Pseudomorph Beds are composed of purple shales and sandstones and contain *Chittidilla plana* King and some brachiopods. The Douposi Formation well exposed in the Wuting and Luquan areas is also composed of purple sandy shales yielding many specimens of *Chittidilla* (Chang *et al.* 1980). The Magnesian Limestone (Schindewolf & Seilacher 1955) like the Lungwangmiao Formation is dolomite to dolomitic limestone.

The upper part of the *Neobolus* Shale contains the trilobites *Ptychoparia geei* King, *P. sakesarensis* King and *Redlichia noetlingi* (Redlich) and several different brachiopods including representatives of *Botsfordia* (Redlich 1901). The two species of *Ptychoparia* have been transferred to the late Early Cambrian Chinese genus *Yuehsiensziella* (Chang 1964). The Wulongjing Member of the Tsanglangpu Formation consists of green sandy shales yielding several species of *Redlichia* and inarticulate brachiopods. The Hongjingshao Member is composed of purple sandstones. The only mismatch is between the

TABLE 1

CAMBRIAN SECTIONS OF EASTERN YUNNAN, CHINA AND THE SALT RANGE, PAKISTAN

	Eastern Yunnan		Kusak, Salt Range
Early Middle Cambrian	Douposi Formation *Chittidilla* 50 m		Salt Pseudomorph Beds *Chittidilla* 85 m
Lower Cambrian	Lungwangmiao Fm. dolomite 100 m		Magnesian Limestone dolomite 75 m
	Tsang-langpu Formation	Wulongjing Member *Redlichia* 50 m	*Neobolus* Shales *Redlichia* 43 m
		Hongjingshao Mem. purple sandstone 100-150 m	Purple Sandstone 107 m
	Chiungchussu Fm.		Saline Series 500 m
	Meishucun Stage		?

Chiungchussu Formation, which does not contain evaporites, and the Saline Series of Pakistan. Otherwise these two sections exhibit an extremely close correlation on lithologies, thicknesses and fossil contents (Table 1).

In the Parahio Valley of Spiti in the Himalaya *Redlichia* is recorded in the middle Haimanta Series with *Oryctocephalus, Pagetia* and ptychoparioids in the upper part of the Series (Reed 1910). Similar faunas are found in the shelf to slope edge biofacies of Kweichow Province in southwestern China. Moreover *Tonkinella* and *Bailiella,* two distinctive trilobites are found in Kashmir (Reed 1934) and in China, the former in southeastern Yunnan, North China, and North America and the latter in central and northern China.

Ordovician trilobite faunas

Ordovician trilobite faunas described from Spiti and Niti in the central Himalaya (Reed 1912) contain the following genera in common with southwest China (Lu 1975)—*Basiliella, Illaenus, Amphilichas, Neseuretus, Sphaerexochus* and *Prosopiscus. Prosopiscus* is only known from Niti and northern Kweichow. According to Gortani (1935), *Illaenus spitiensis* and several species of brachiopods are common to the Himalaya and the Karakorum. The Ordovician fauna of the Karakorum is also closely related to those of southwestern China.

It should also be noted that Ordovician nautiloids described from Nyalam County, southern Tibet south of the Tsang-Pu River (Chen 1975) have several taxa in common with the faunas of the Yangtse Gorge section in China and other taxa found commonly in China.

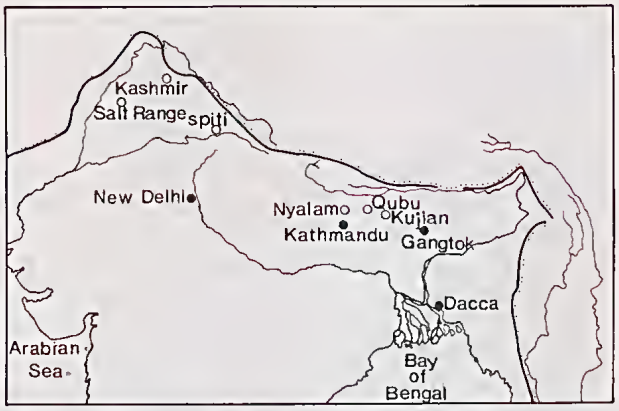

Fig. 3—Sketch map showing localities on the northern margin of the Indian block and its collision boundary with the Eurasian block (After Yeh, Liang, Shen & Xiang 1975, fig. 2).

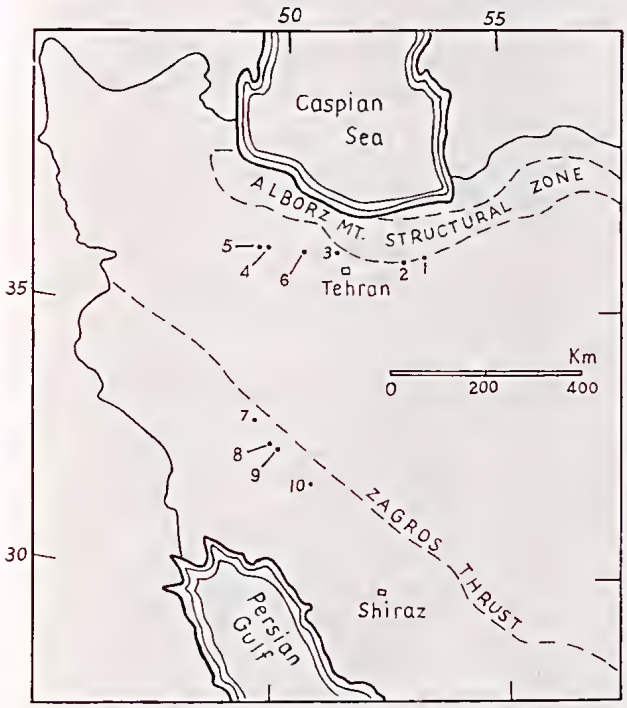

Fig. 2—Sketch-map of part of Iran.

1. Mila Kuh
2. Shahmirzad
3. Haanakdar
4. Abhar
5. Quanli-Chapoghlu
5. Quanli-Chapoghlu
6. Sanghabad
7. Chal-i-Sheh
8. Darreh Shu
9. Tang-i-Tehbud Bezuft
10. Ma'dan

Chelidonocephalus alifrons King is recorded from localities 1, 3, 4, 5, 7, 8, 9.
Iranoleesia pisiformis (King) is recorded from localities 1, 3, 4, 5, 10.
(After Fortey & Rushton, 1976, p. 322, fig. 12)

CONCLUSIONS

Close similarities in the Cambrian and Ordovician endemic faunas of the northern margin of Gondwanaland and of China constitute sufficient evidence to seriously question or even deny separation by a vast ocean or deep water of any kind.

As a result of the study of the Cambrian stratigraphy and palaeogeography in Middle South Asia (Iran to North India), R. Wolfart and M. Kursten (1974) came to the conclusion that "According to the hypothesis of continental drift in the sense of Dietz & Holden (1970), for example, the Arabian Peninsula should have been situated in southern latitudes during the Cambrian separated from the Asian continent by a wide sea basin of the Tethys. The Cambrian geological conditions of Middle South Asia, on the contrary

point to the conclusion that Arabia, the Indian Peninsula and Asia geographically were immediate neighbours during that time." I agree with this conclusion.

Many modern reconstructions of the early Palaeozoic world differ in the relative situations of China, Chinese Tibet and India. For example Ziegler *et al.* (1977) placed Chinese Tibet on the equator contiguous with the rest of western China and directly opposite Australia across a seaway. Two years later the same group of authors Scotese *et al.* (1979) placed Chinese Tibet adjacent to India but very distant from China. In both cases Iran was split, presumably along the Zagros thrust line by a considerable distance. Smith, Briden & Drewry (1973) separated the Indian and Afro-Arabian plates from the rest of Asia although they were on the shores of the same rather narrow seaway. Jell (1974), also separated India, and Chinese Tibet-China by a considerable distance. These reconstructions as well as those of Cowie (1971), Bulman (1971) and Dietz and Holden (1970) already mentioned and others could be improved by consideration of the lithological and palaeontological data outlined above.

The discussion of faunas across the gape in Pangaea between Australia-Antarctica-India and southern Asia goes towards more concrete evidence for non-existence of this gape as propounded by Carey (1976) and used by him as evidence of a smaller radius Palaeozoic earth. While not making any comment here on the validity of the Expanding Earth Theory, Carey's claims that Tethys did not exist in the Palaeozoic appears valid in the detail as well as the general.

Although some individual faunal affinities may be explicable on the basis of other factors there is now so much evidence amassed that a wide Tethys Sea between the Indian, Afro-Arabian and Australian Plates on one hand and China on the other through much of the Palaeozoic seems quite impossible.

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